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Completion Report

Estimating Creel Statistics and Walleye Exploitation on Island Lake Reservoir (DOW # 69-037200), Minnesota using a Stratified Random, Roving Creel Survey and Walleye Tagging

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Introduction

Island Lake Reservoir (DOW # 69-037200) is the largest of five headwater storage basins in the St. Louis-Cloquet system created by Minnesota Power (MP) in the early 1900's for the purpose of hydroelectric power generation. The premise of Island Lake Reservoir is to store water during high natural flow periods (April-May) and release water when natural flows are low (November-March) to provide a renewable energy resource for a 26,000 square-mile electric service territory in northeastern Minnesota. Minnesota Power (MP) successfully obtained a permit to operate and maintain the 88 megawatt St. Louis River Project from the Federal Energy Regulatory Commission (FERC) in 1964 making it effective on January 1, 1950. Under this license, no minimum flows on the Cloquet River were established and MP was allowed to drawdown the reservoir to an elevation of 14.5 feet. In 1991, MP filed an application for a new license and on July 13, 1995, the FERC issued MP a new 30-year operating license that contained several provisions that would better protect fish and wildlife populations. Included in the new license provisions, MP was allowed to draw down Island Reservoir to a minimum staff gage of 20 feet in winter, while maintaining full pool elevation of 38.5 feet by June 1. In addition, minimum flow requirements were established for the protection and enhancement of fish and wildlife resources and recreational resources in the Cloquet River. However, the FERC license also identified that flows and staff gage elevations may be temporarily modified if required by operating emergencies beyond MP's control or upon agreement between MP, the Department of Interior, and the Minnesota Department of Natural Resources (MNDNR). Modifications to minimum flows and pool elevation are most common during drought years. In drought years between 1970 and 2003, pool elevation rarely reached current target elevation levels, but since the minimum flows have been established, the magnitude of water level fluctuation has decreased considerably.

The Island Lake Reservoir is managed for recreational use of multiple species, but is focused on walleye and muskellunge (MN DNR 2005). Stocking sport fish to enhance angling opportunities has been used as a management technique since the early 1930's in Island Reservoir (Table 1). Island Lake Reservoir had no special regulations during the 2006 angling season.

Island Lake Reservoir has historically supported a popular walleye fishery. To bolster and maintain the walleye population, the MN DNR stocked over 16 million walleye fry beginning in 1931. In 1989, a full survey was conducted to determine the contribution of stocked walleye fry. Analysis of age distribution from this investigation demonstrated that a small percentage of the fish captured correlated to stocked year-classes. This indicated strong natural reproduction allowing walleye stocking to be discontinued. Subsequent surveys and assessments have shown constant recruitment and no negative effects of discontinued stocking.

Muskellunge fingerling, fry, and yearling have been stocked periodically since 1963; however, muskellunge fingerlings have been stocked at one to two year intervals since 1992. A netting assessment was conducted to evaluate the success of stocked fingerling muskellunge in the spring of 2003. During this investigation, muskellunge trapnet CPUE was 0.22 per lift. Mean length was 32.3 inches and length at age 4 was 28.8 inches. Muskellunge PSD was 92 and represented excellent size potential. Analysis of age distribution revealed that 64% of fish were correlated to stocked years. However, muskellunge are difficult to age accurately and results may not be reliable. Muskellunge management still includes stocking 2,500 yearlings in even years.

A recreational use study was conducted in 1999/2000 and estimated that Island Reservoir received 82,798 hours of total angling and 10.0 hours of fishing pressure per acre (Table 2). Although Island Reservoir received the most angler hours of any inland lake in the Duluth Area, fishing pressure on Island Reservoir was categorized as moderate, based on hour per acre usage. Due to its large size and close proximity to Duluth, Island Reservoir has been a popular destination for tournament fishing contests. Between 2002 and 2007, MNDNR has issued 31 fishing tournament permits.

The specific goals and objectives of this study were to (1) estimate angler pressure, catch rates, and harvest rates; (2) quantify which species were being targeted; (3) collect angler demographic data; (4) estimate the walleye population size; and (5) estimate walleye angling exploitation rate. This information will help guide future management of fish species on Island Lake Reservoir.

Study Area

Located 10 miles north of Duluth, MN, the Island Lake flowage basin is the largest and deepest of the water storage reservoirs covering 8,280 acres and reaching maximum depths of 94 feet. Over 39% (3,260 acres) of the surface area is littoral. Seasonal water level fluctuations historically ranged between 6 and 25 feet, however current winter drawdowns are usually less than 12 feet. Magnitude of drawdowns are dependent on seasonal rain and snowfall accumulation in the watershed and power generation needs. Island Reservoir is in lake class 2 with an area priority rating of 12 on a scale of 1 to 14 (14 being the highest).

Northeast Minnesota rivers and lakes were formed primarily through scouring of Precambrian rock by glacial ice sheets and are typically the most unproductive in Minnesota (Schwartz and Thiel 1954; Moyle 1956); however, man-made reservoirs have accelerated rates of eutrophication and are generally much more fertile. Island Lake Reservoir is classified as borderline mesotrophic/eutrophic with a Carlson Trophic State Index score of 51.8 (Carlson's Trophic Index; Citizen Lake-Monitoring Program).

There are three public access areas on Island Reservoir that are owned and operated by MP. Abbott road and Hideaway access areas are located off of County Road #4 and provide access to the reservoir via the central basin and the east basin, respectively. The Dam Road access area is located near the outlet of the Cloquet River off County Road #275 and provides access to the reservoir via the south basin.

Most of the shoreline is owned by MP, which in turn leases shoreline lots to private individuals for development. Development on Island Reservoir has steadily increased from 34 cabins in 1942, to 200 in 1954, and 326 in 1978. A total of 733 homes were identified along the shoreline of Island Reservoir during the 1994 lake survey.

Methods

Creel Survey Design

A roving, stratified creel survey was determined to be the best survey method for this reservoir due to the high number of cabins and permanent homes on the lake. An access-based survey would underestimate pressure and harvest estimates. The survey was stratified season, day type, and time of day (Table 3). Seasons were spring (May 13, 2006 – June 30, 2006), summer (July 1, 2006 – August 31, 2006), fall (September 1, 2006 – October 21, 2006), early winter (December 1, 2006 – January 15, 2007), and late winter (January 16, 2007 – February 25, 2007). For analysis purposes, seasons were combined into sampling periods: open water (spring, summer, and fall) and winter (early winter and late winter). Day type consisted of weekends (including holidays) and weekdays. Days for spring, summer, and fall were divided into two time periods based on total daylight hours. Early and late winter strata only contained one time period (Table 3). These strata were selected to account for temporal changes in angling patterns, species being targeted, and standard workweek hours.

Day length dictated the number of work shifts in a day. The first three seasons had two work shifts due to longer daylight times. Shorter days in the winter required only one shift per day (Table 3). Morning and evening shifts were randomly selected for those seasons with two shifts.

Within each season, all weekends/holidays were scheduled to be sampled and weekdays were selected randomly. A creel clerk worked five, eight-hour workdays per week during two-shift strata and four ten-hour workdays per week during one-shift strata. During open water strata, that worked out to two or three (dependant on holidays) randomly selected weekdays per week. In the winter, it worked out to one or two (dependant on holidays) randomly selected weekdays per week.

Since Island Lake Reservoir is large and complex, the reservoir was divided into four distinct basins: east, central, south, and west (Figure 1). Two basins were randomly assigned on scheduled creel survey days, each accounting for one half of a work shift. A direction of movement, clockwise or counterclockwise, was randomly chosen for each day. An instantaneous count time was randomly chosen for each basin on a scheduled workday (Figure

2). At the beginning of a shift, the clerk reported to the assigned start location and interviewed anglers as encountered, traveling in the direction assigned. At the scheduled count time, the creel clerk would stop interviewing anglers and circumnavigate the basin. During the open water count, the clerk counted the total number of bank and dock anglers, the total number of boats with anglers, and recreational users. During the winter count, the clerk counted the total number of open ice anglers, total number of icehouses in use, and recreational users. After completing the count, the clerk would continue interviewing anglers. After approximately half of the scheduled on-water time, the creel clerk proceeded to the second randomly assigned basin and repeated the interview and count process. Open water counts and interviews were done using a boat. Winter counts and interviews were done using a snowmobile.

Interviews were conducted on a party basis. Information collected relative to the trip included: start time, time of interview, number of people in the party, access used, species sought, complete or incomplete trip, number of lines, angler type, fishing method, lure type, boat description, motor size and type, presence of trolling motor, use of electronics, age, gender, and angler residence (zip code). All information was optional and the angler/s had the option of refusing the interview. Interviews were randomized both temporally and spatially on days when the clerk was unable to interview every party in the allotted time within a basin.

Information relative to catch included: species and length of harvested fish, and species and number of released fish. The clerk measured all harvested fish to the tenth of an inch. When lengths of released and harvested fish were unavailable for measurement, anglers were asked to estimate the size of each fish. The creel clerk recorded tag numbers from all observed tagged walleye and thoroughly checked other harvested walleye for signs of tag removal or tag loss. If an angler reported releasing tagged fish, the information was noted in the comments section of the interview form.

To increase the amount of completed-trip interview data collected, incomplete fishing parties interviewed were given a simple postcard questionnaire (postage-paid) addressed to the area fisheries office. The clerk was required to fill out the date of the interview along with the interview number prior to handing out the postcard questionnaire. Anglers were asked to fill out

and mail the questionnaire at the end of the fishing trip. Anglers were asked to provide information on party size and the duration of fishing trip, number and size of harvested and released fish, and the tag numbers from any fish harvested.

Analysis

Fishing pressure, catch rates, targeting catch rates, harvest rates, and yield (pounds of fish) were estimated using the windows based Creel Application Software (CAS) program (Soupir and Brown 2002). CAS was developed to aid in creel survey data entry and analysis and most analysis was run with this program. Applicable equations for estimates and error can be found in the CAS supporting documentation. For analysis that could not be run in CAS, raw data were exported into excel and formatted for the specific analysis.

Island Lake Reservoir creel data, both pressure counts and interviews, were entered into the program. In order to increase completed trip data, questionnaire cards were handed out to angling parties. With this additional data, two databases were made for Island Lake Reservoir. The first included only data from pressure counts and interviews. The second expanded on the first by adding data from returned questionnaires. Individual questionnaires were compared to the original interviews as a way to verify reasonable correctness. Cards with discrepancies or missing total fishing time were excluded from the database. This allows flexibility in analysis when the accuracy of returned questionnaire cards is in question.

CAS allows the user to calculate angling pressure from pressure counts and interviews. The program calculates average party size and time spent angling and is reported by season and angling type. It uses this information in combination with pressure counts to calculate total fishing pressure. Fishing pressure is reported as angling hours and angler-hours/acre by season, sampling period, and type of fishing.

CAS calculates total catch per unit effort (CPUE) and also splits it into harvest per unit effort (HPUE) and release per unit effort (RPUE). Creel data was further analyzed for rates of parties targeting a species. Percentage of anglers targeting a species was calculated for species by season, sampling period, and entire angling season in excel. CAS was used to calculate CPUE,

HPUE, and RPUE by targeted species. CPUE, HPUE, and RPUE rates are reported by species, season, sampling period, and entire angling season.

The total number of harvested fish and harvested pounds of fish were also calculated in CAS. They are reported by season, sampling period, and species. Mean lengths and associated standard errors for harvested and released fish were calculated by pooling data by sampling period and for the entire year. Individual weights were calculated for all measured fish using length-weight relationships derived from fish population investigations on Island Lake Reservoir conducted in 1994, 1998, and 2003. Mean weights and standard errors were calculated the same way as lengths. Mean lengths and weights are reported by sampling period and for the entire angling season.

Numerous angler demographic data was collected during the creel survey, and was analyzed in MS Excel and reported as a percentage of total responses. Demographic information reported for the open water sampling period includes: angler type, lake access used, outboard motor size (boat anglers only), trolling motor present (boat anglers only), fishing method, and bait used. Demographic information reported for the winter sampling period includes: angler type, lake access used, fishing method, and bait used. Demographic data were pooled and reported for the entire angling season for angler residence (zip code), gender, and age. Areas of interest for angler residence were local, nearby urban areas, MN residents, and out-of-state anglers. Local area residents were considered those with the same zip code as Island Lake, 55803. Nearby urban areas included the Duluth Metropolitan area (Duluth, Hermantown, and Proctor), Cloquet/Esko, and Superior.

Walleye Popultion Size and Exploitation Estimation

A walleye mark/recapture plan was developed to obtain better estimates of population size. Fish were captured using boat electrofishing and marked with floy tags during the spring of 2006. Only fish greater than or equal to 10 inches were marked. Recaptures mainly relied on anglers during the angling season. The creel clerk recorded any tagged walleye harvested during the scheduled shift. The clerk also noted any tagged fish that the angler released. Additional capture information was obtained from gillnet and trapnet samples from a full survey conducted during

the summer of 2006. Drop boxes and educational signs were placed at three public access sites and one private access to inform the public and collect tags returned voluntarily by anglers over the angling season. Additional walleye information was also gathered by handing out postage-paid postcards to interviewed anglers who had not completed their fishing trip.

A population estimate was obtained by using the Bailey modification to the Peterson estimate (Van den Avyle and Hayward 1999). The equation used is

$$N = M (C + 1) / (R + 1), \quad (1)$$

with standard error

$$SE(N) = \sqrt{[(M^2 (C + 1) (C - R)) / ((R + 1)^2 (R + 2))]}, \quad (2)$$

where N is estimated population size, M is the number of fish marked, C is the number of fish collected during the recapture period, and R is the number of recaptures found in C. Since only fish greater than or equal to 10 inches were marked, the population estimate is for fish in this length category. To adjust for fish recruiting into the population from growth, lengths of captured fish were adjusted based on growth rates calculated from the 2006 MN DNR fisheries full survey conducted on Island Lake Reservoir. Length of fish on May 1 was estimated using

$$L1 = L2 - (D * G), \quad (3)$$

where L1 is the estimated length on May 1, 2006, L2 is length at capture, D is growing days, and G is daily growth. Only fish greater than or equal to 10 inches were used for population estimation.

Total annual mortality was calculated using data collected from previous MN DNR surveys on Island Lake Reservoir using catch curve analysis (Van den Avyle and Hayward 1999). Using number fish collected versus age can be used to solve for Z in the following equation:

$$\log_e (N_t) = \log_e (N_0) - Z (t), \quad (4)$$

where N_t equals number alive at time t, N_0 is the number alive initially, and Z is the instantaneous total mortality rate. Survival, S, can than be estimated as

$$S = e^{-Z}. \quad (5)$$

Natural and angling mortality was separated using harvested tagged walleye estimates. Angler exploitation over the entire fishing season was calculated by using the estimated number of

tagged walleye harvested divided by the total number initially tagged. As with the above, only fish greater than or equal to 10 inches were used in the analysis.

Results

Creel Survey

A total of 1,169 interviews were conducted on Island Lake Reservoir during the 2006-07 angling season (Table 3). The open water sampling period accounted for 92.2% of total interviews. All weekend days were sampled during the spring, summer, and fall seasons. Ice conditions and staffing issues reduced sampling to 80.0% of weekend days during the winter sampling period. The creel clerk sampled 58.0% and 31.1% of weekdays for the open water and winter sampling periods respectively.

A total of 1,074 questionnaire cards were handed out to angling parties who were still fishing. Duluth Area received 243 cards back for a 22.6% return rate. Of the returned cards, 217 were useable and the information was added to the creel survey data. Cards were rejected for not matching up with a creel sheet (11), no total hours written down (10), or had unusable information (5). This expanded dataset was used as the default dataset unless otherwise specified.

Fishing Pressure

Average party size was 2.06 anglers per party in the spring and decreased every sampling period to 1.71 anglers per party in late winter (Table 4). The trend was similar with mean number of hours fished. The highest occurred in the spring with parties averaging 4.74 angling hours and decreasing to 3.15 hours in the late winter (Table 4). Using these estimates, total fishing pressure for Island Lake Reservoir during the 2006/2007 fishing season was estimated at 80,436 hours (SE = 11,820).

Fishing pressure during the open water period, 66,137 angler hours (SE = 3,943), accounted for 82.2% of all fishing pressure (Table 5). Most fishing pressure occurred during the spring and summer, 43.8% and 29.0% of total angling hours respectively. Although angler effort in Island Lake Reservoir was high during the spring and summer, measurable fishing pressure occurred during all seasons. Boat anglers accounted for nearly 81.1% of all hours spent fishing, (Table 5).

Shore angling was popular during the spring accounting for 68.6% of all shore angling hours. Although numerous lakeshore properties are located along the shore of Island Lake Reservoir, very few residents fished from their docks during any part of the open water creel (Table 5).

About 14,299 angling hours were spent fishing thru the ice with 93.9% of this effort occurring during late winter (Table 6). A standard error of 11,143, almost equaling estimated pressure, indicates high variability in daily fishing pressure. Most anglers that fished during the winter used either a portable or permanent fish house (Table 6). Open ice anglers were more frequently observed during the late ice period when ice conditions were safe for driving vehicles, snowmobiles, or ATV's. No spear fishing pressure was observed during the creel.

Angling rates, Harvest, and Yield

Black crappie were not a highly targeted species with only 0.9% of anglers targeting them in the open water period, and jumping to 15.4% in the winter period (Table 7). Black crappie catch rates for all anglers ranged from 0.003 fish per angler hour in the spring to 0.133 fish per angler hour in early winter. Harvest rates followed the same trend with 0.001 fish per angler hour in the spring and 0.115 fish per angler hour in early winter (Table 8). Anglers targeting crappies had the highest catch rates in the fall. Black crappie total harvest and yield was very low (571 fish and 421 pounds), with harvest being the highest in fall (Tables 9 and 10). Results from this study show that black crappie represent a small proportion of total harvest (4.0%) and yield (4.5%). The mean length of black crappie harvested was 11.6 inches during the open water period and 10.3 inches during the winter period (Table 11). Most anglers did not harvest black crappies that were less than 9 inches.

Anglers harvested very few smallmouth bass, only 7.7% of bass caught, during the 2006-07 fishing season (Table 12). Smallmouth bass were not highly targeted, with only 2.9% of open water angling parties targeting them (Table 7). All catch, targeting, and harvest of smallmouth bass occurred during the open water period (Table 7 and 8). Highest catch rates occurred in spring at 0.077 fish per angler hour, and declined to 0.037 fish per angler hour in the fall. Anglers who targeted smallmouth bass had the highest catch rates in the fall. Harvest rate of smallmouth bass was 0.007 fish per angler hour for the 2006/07 season (Table 8). The mean

length of smallmouth bass harvested, 13.7 inches, was slightly larger than the mean length of bass released, 13.1 inches (Table 11). No bass less than 10 inches were harvested. Smallmouth bass accounted for 3.8% of fish harvested and 9.1% of the total yield (Tables 9 and 10).

Northern pike were also not heavily exploited, accounting for 3.3% of fish harvested and 10.2% of the total yield, with the highest exploitation occurring in the spring (Tables 9 and 10). Only 1.5% of anglers targeted northern pike during the angling season (Table 7). Of the northern pike caught, only 9.3% were harvested (Table 12). Catch rates ranged from 0.020 to 0.070 fish per angler hour. The fall period had the highest catch rates for anglers targeting pike. Harvest rates were low reaching a maximum rate of 0.012 fish per angler hour in the fall (Table 8). The mean length of fish harvested was 25.7 inches during the open water period and 26.1 inches during the winter. Released fished averaged 17.5 and 17.4 inches during these same time periods respectively (Table 11). Anglers only harvested fish over 17 inches and released fish almost always outnumbered harvested fish per length category (Table 12).

Muskellunge were the second most targeted species at 5.9% of angling parties on Island Lake Reservoir (Table 7), but accounted for less than 1% of total fish harvested and total yield (Tables 9 and 10). Of the fish caught in the creel (18 fish), only one undersized fish was kept. Upon being notified of state regulations, the fish was released but likely did not survive and was counted as harvested in the analysis (creel clerk notes). Angler caught muskellunge ranged from 25-49.5 inches long, averaging 36.3 inches (Table 12). Muskellunge angling only occurred during the open water period with catch rates ranging from 0.001 to 0.006 fish per angler hour. Muskellunge specific anglers had the highest catch rates during the summer season (Table 8).

Yellow perch were hardly targeted on Island Lake Reservoir with only two parties targeting the species the whole year (Table 7). This low pressure translated into a very little exploitation with only 658 fish harvested for 342 pounds of yield, representing 4.5% of the harvest and 2.7% of the yield (Tables 9 and 10). Highest harvest occurred during the summer season both in terms of fish numbers and harvest rate (Table 8). The average size of harvested yellow perch was two inches greater in the open water period as opposed to the winter period (Table 11). Catch rates

were typically low with best angler success occurring in early winter, 0.076 fish per angler hour (Table 8).

Walleye was the most sought after fish with 72.1% of interviewed anglers targeting this species (Table 7). Catch rates ranged from 0.038 fish per angler hour in late winter to 0.561 fish per angler hour during the summer. Anglers targeting walleyes had the highest catch rates in the summer, but averaged greater than 1.0 fish per angler hour for the open water period (Table 8). An estimated 12,399 walleye (9,247 lbs) were harvested during the 2006-07 fishing season representing 84.3% of the total catch and 73.4% of total yield (Tables 9 and 10). These rates were the highest of any species. Spring (5,119 fish) and summer (5,449 fish) harvests were similar and accounted for 85.6% of all harvested walleye. Walleye comprised the most fish harvested in all seasons (Tables 9 and 10). Anglers harvested walleye down to five inches but the higher frequency of harvest did not begin until fish reached 12 inches (Table 12). Mean length of walleye harvested in the open water period was 13.1 inches. Mean length of walleye harvested in the winter period was 13.7 inches (Table 11).

Angler Demographics

Local residents accounted for 6.4% of the anglers interviewed on Island Lake Reservoir in 2006-07 (Table 13). Duluth area residents accounted for the biggest portion of anglers on Island Lake Reservoir at 76.6%. Nearby Cloquet/Esko accounted for 3.0% of interviews. Only 19 anglers (0.8%) were from Superior, WI. Out-of-state license fees probably deter many Wisconsin anglers, even though the reservoir is located only a few miles from Superior. Overall, Minnesota residents accounted for 94.7% of anglers on the water. The remaining anglers journeyed from 15 different states.

Anglers were predominantly male, 83.4% (Table 13). All age classes of anglers were represented but 68.1% of anglers were between 25-54 years old (Table 13).

Boat angling was the most popular method followed by bank anglers and then dock anglers during the open water period (Table 13). Motor size was variable with 79.9% also employing a trolling motor (Table 14). Anglers most frequently used public boat ramps to access the lake;

however, private residences were also heavily used (Table 14). Still fishing and trolling were the most popular fishing methods (Table 14). Minnows were the bait of choice for Island Lake Reservoir (Table 14).

Ice anglers predominantly used fish houses with a few anglers fishing on the open ice (Table 13). Of the limited number of ice anglers, 79.1% originated from private residences. Anglers almost exclusively "still" fished with minnows (Table 14).

Walleye Populution Size and Exploitation

Between April 17-25 2006, Fond du Lac Band, 1854 Tribal Authority, and the MN DNR captured and marked 4,961 walleye ($\geq$10 inches) with individually numbered floy tags and then released them back into the lake. The recapture period began with the angling season opener on May 13, 2006 and lasted to the walleye closer on February 25, 2007. A total of 3,147 fish were reported in the creel, of which 2,598 were greater than or equal to 10 inches. In the recapture count, 131 had tags. An additional 117 fish were added from gillnet and trapnet captures during the MN DNR survey. Thirteen of these fish possessed tags. This produced a walleye population estimation of 92,925 fish with a standard error of 7,482.

The numbers of walleye at a given age were combined from surveys (unpublished data) conducted in 1998, 2003, and 2006 (Figure 3), because sample size for individual years was too small. Ages three through eight were used for the analysis. This range was used because walleye did not fully recruit to the sampling gear until age three and sample sizes per age group were too small (<5) after age eight. Estimated survival was 55.9%, so walleye have an estimated 44.1% mortality rate in Island Lake Reservoir. An estimated total of 844 tagged walleye were harvested from Island Lake Reservoir during the 2006-07 angling season. Divided by the total number of tagged walleye, estimated exploitation of walleye equals 17.0%. Using these estimates of total and angling mortality, annual natural mortality is estimated at 27.1%.

Discussion

Fishing Pressure

Island Lake Reservoir received approximately 8.0 angler hours per acre during the 2006-07 fishing season. The estimated fishing pressure in this study was slightly lower than the 10.0 angler hours per acre observed by Rust (2001) during an aerial recreational use survey (Table 2). Meerbeek (2006) also found similarity between creel and aerial recreational use results on Fish Lake Reservoir. These results help justify aerial recreational use estimates for angling pressure. Rust (2001) also estimated fishing pressure for other reservoirs within the St. Louis River/Cloquet river system and found that despite low to moderate angling pressure per acre, Island Reservoir had the most angler hours.

Like most other large lakes or reservoirs in the area, Island Lake Reservoir supports a significant open water fishery with a greatly reduced winter fishery (Table 2). Island Lake Reservoir has almost twice as much angler pressure than the average water body in lake class 2. This extra pressure came during the open water period, as winter pressure was only slightly larger in the Reservoir than other class 2 lakes. However, total fishing pressure was only about 33% of the state average for all lakes (Cook and Younk 1998; Table 2).

As expected, the highest amount of pressure, 43.8% occurred during the spring season. Most lakes that have good populations of sport fish have elevated fishing pressure during the spring when fish concentrate in spawning locales and metabolism increases. Meerbeek (2006) estimated that 36% of angler pressure occurred during spring on Fish Lake Reservoir. Lindgren (2004) estimated that over 70% of angling pressure occurred during the spring in the nearby St. Louis Estuary.

Winter pressure estimates were almost four times greater in the creel study than in the aerial recreational use study. As mentioned earlier, the creel estimate of winter pressure also has a high standard error. Looking closer at individual pressure counts did produce one outlier. Island Lake had one ice fishing tournament during the 2006-07 winter sampling period, January 28, 2007. Tournament records indicated approximately 500 participants. Excluding this day from the sample and rerunning the analysis in CAS for the winter period estimated angler pressure at

3,123 angler hours with a standard error of 902. This would reduce angler hours per acre to 0.4 for the winter period. This is much more in line with the aerial recreational use study. The overall pressure would be reduced to 69,260 angler hours (8.4 angler hours per acre). Even with this reduction, only Fish Lake Reservoir and the St. Louis Estuary would have higher amount of angler hours in the Duluth Area.

Black Crappie

Island Lake Reservoir is not a crappie destination despite the potential for harvestable fish. Black crappie average harvest lengths were higher than those found on the St. Louis Estuary and Fish Lake Reservoir (Lindgren 2004 and Merbeek 2006). This is likely a result of few anglers targeting black crappie combined with more crappies being caught as bycatch. It is reasonable to assume that these crappie lengths are skewed towards longer fish since they were caught with tactics targeting larger fish. Black crappie fishing opportunities in Island Lake Reservoir are minimal. All but one black crappie catch rate in DNR surveys has been below the interquartile range and analysis of age distributions have indicated erratic recruitment (Duluth Area lake management files). The black crappie population is likely not large and/or consistent enough to be an attractive destination for crappie anglers. Additionally, winter ice conditions are often poor on the reservoir, limiting the ability of anglers to fish for crappies during this popular time period.

Smallmouth Bass

Although very few bass were harvested in Island Lake Reservoir, it was the second most caught species in the lake. Low harvest rates indicate more about bass angler mentality than on the size structure of the population as indicated by the average size of fish released (Tables 11 and 12). The most current lake management plan (2005) shows good growth and excellent size potential. It also indicates that the smallmouth bass population has been fairly low until recent years. This is likely the reason for low target rates. As the population expands and more anglers discover this fishery, it is reasonable to expect an increase in smallmouth bass fishing on Island Lake Reservoir.

Northern Pike

Northern pike were the objective for very few anglers on Island Lake Reservoir. Minnesota DNR survey net catches (2005) have typically fallen within the interquartile range for the

reservoir. Size structure of the population may deter people from choosing Island Lake Reservoir as a pike destination. Only one trophy fish (> 34 inches) was sampled in the creel. Anglers may be targeting other area lakes where northern pike populations are more vulnerable.

Muskellunge

Island Lake Reservoir is one of two muskellunge fisheries in the Duluth Area. The total mean catch rate for anglers targeting muskellunge (0.018 fish per angler hour) was lower than reported rates of 0.04 fish/angler-hour in northern Wisconsin (Simonson 2003), 0.03 fish/angler-hour in Minnesota (Younk and Pereira 2003), and 0.04 fish/angler-hour in Ontario (Duffy and Mossindy 2000). The angling public often judges a muskellunge population on the number of fish over 40 inches and the potential to produce trophy fish over 50 inches. Only about 25% of the muskellunge in the creel sample were 40 inches or greater. None were over 50 inches. Despite consistent stocking of muskellunge since the early 1990's, little is known about the Island Lake Reservoir muskellunge population. A special assessment survey was conducted in 2003 and one is scheduled for 2008. These surveys should shed more light on the status of the population.

Muskellunge life history (Scott and Crossman 1973; Cook and Solomon 1987; Casselman et al 1999) combined with current musky angler ideals (Simonson 2003; Margenau and Petchenik 2004) have generally kept exploitation levels low in the recent past. This was seen in the muskellunge population on Island Lake Reservoir. Only one fish was harvested in the creel. As the number of large fish in the system increases, it can be expected that the harvest levels will increase as people begin keeping trophy size fish.

Yellow Perch

Yellow perch are typically bycatch for anglers fishing on Island Lake Reservoir. It is unknown why perch are not targeted in the reservoir. Many of Minnesota's large lakes support a healthy yellow perch sport fishery (MN DNR 1997), but it apparently has not caught on at Island Lake Reservoir. This may be related to potential poor size structure and/or population size in the reservoir, despite data from recent fisheries surveys. The last full MN DNR survey in 1994 showed good size potential and fast growth compared to other Duluth Areas lakes (MN DNR 2005).

Walleye

Open water catch rates on Island Lake Reservoir were more than twice the catch rate of 0.24 fish per angler hour on nearby Fish Lake Reservoir (Meerbeek 2006) and was similar to the catch rate of 0.41 fish per angler hour on the St. Louis Estuary (Lindgren 2004). Harvest rates were similar in all three water bodies ranging from 0.10 fish per angler hour on Fish Lake Reservoir to 0.18 fish per angler hour on Island Lake Reservoir.

However, the mean size of fish harvested varied between all three water bodies, the largest from the St. Louis Estuary. The larger size of harvested walleye was expected in the Estuary because regulations only allow for harvest of two fish with a minimum size limit of 15 inches and walleye growth is faster. Walleye regulations in Fish Lake Reservoir and Island Lake Reservoir fall under the statewide regulation of a 6 fish daily bag limit, with only one over 20 inches. Fish harvested in Island Lake Reservoir were on average 1.3 inches smaller than those harvested on Fish Lake Reservoir during the open water period. Interestingly, the mean size of released fish was almost 0.5 inch greater on Island than on Fish. Minimum size limits of 15 inches typically do not increase walleye growth or catch rates (Fayram et al. 2001).

Annual natural mortality for walleye was estimated at 44.1%, which is within the range of mortality rates for adult walleye in North America (13-80%) reported by Colby et al. (1979) and similar to those observed from Kansas Reservoirs and several Wisconsin lakes (Beard et al. 2003; Quist et al. 2004). Total annual mortality was higher in Island Lake Reservoir than in Fish Lake Reservoir (Meerbeek 2006). Walleye angling mortality was an estimated 17.0%, below the estimated 19.1% found on Fish Lake Reservoir (Meerbeek 2006).

Historically low PSD calculations indicate an unbalanced walleye population. Communications with Island Lake Reservoir anglers also suggest that the walleye are smaller than preferred. Regulations like minimum lengths and slot limits may be a tool to manipulate size structure but need to be rigorously examined before being instituted. The information learned from this study combined with past MN DNR survey data will allow managers to simulate and test potential management decisions.

Conclusions

Island Lake Reservoir is a popular fishery for both Duluth area residents and state of Minnesota residents. The open water fishery on Island Lake Reservoir has proved to be substantial. Angler hours were near the highest in the Duluth Area and pressure was above the state median values for lake class 2 lakes. A significant seasonal difference in fishing pressure was observed, with the highest pressure during the open water period, especially spring, and low winter pressure. Walleye were by far the most targeted species and contributed the most to annual yield, but muskellunge and smallmouth bass were also targeted. The walleye population provided excellent catch rates, though average size of fish harvested lagged behind other popular area water bodies. Island Lake Reservoir also contains other quality fisheries that are lightly targeted at this time.

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Tables

Table 1. Island Lake Reservoir (DOW # 69-037200) stocking history.

	MUE			NOP				WAE			BLG		LMB	BLC		
Year	FRY	FGL	YRL	FRY	FGL	YRL	ADL	FRY	FGL	ADL	FGL	YRL	FGL	FGL	YRL	ADL
1931-1949	0	0	0	0	0	0	300	10,258,500	0	0	1,500	0	7,500	0	0	37
1950's	0	0	0	0	0	0	21	240,000	300	342	0	0	0	0	0	0
1960's	93,030	0	206	300,000	64,027	2	434	1,950,000	0	0	0	4,145	0	3,036	47	603
1970's	0	1,718	1,334	0	106,800	0	40	300,000	0	0	0	0	0	0	0	0
1980's	0	0	540	0	0	270	0	3,567,070	0	0	0	0	0	0	0	0
1990's	0	18,762	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000's	0	10,334	66	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	93,030	30,814	2,146	300,000	170,827	272	795	16,315,570	300	342	1,500	4,145	7,500	3,036	47	640

FRY = Fry FGL = Fingerlings YRL = Yearlings ADL = Adult

Table 2. Comparison of fishing pressure (angler-h/acre) from recreational use and creel surveys conducted on various St. Louis County reservoirs, the St. Louis Estuary, lakes from across Minnesota, and lake class 2 average.

	Fishing Pressure (angler hrs/acre)		
Waterbody	Open	Ice	Annual
Island Lake Reservoir			
2006-2007 Creel	8.0	1.7	9.7
1999-2000 Rec. Use Survey[a]	9.5	0.5	10.0
Fish Lake Reservoir			
2005-2006 Creel[b]	18.7	7.1	25.8
1999-2000 Rec Use Survey[a]	16.9	4.4	21.2
Whiteface Reservoir[a]	13.6	0.6	14.2
Boulder Lake Reservoir[a]	5.9	0.9	6.8
Wild Rice Reservoir[a]	10.3	1.2	11.4
St. Louis Estuary[c]	25.7	1.0	26.7
Lake Class 2 Average[d]	4.8	1.1	5.9
State Average[d]	31.7	4.5	34.6

[a] Recreational use pressure estimates from Rust (2001)
[b] Fish Lake Reservoir pressure estimates from Merbeek (2006)
[c] St. Louis Estuary pressure estimates from Lindgren (2004)
[d] Numbers generated by Cook and Younk (1998)

Table 3. Stata used in the Island Lake Reservoir (DOW # 69-037200) creel during the 2006-07 angling season.

	Spring	Summer	Fall	Early Winter	Late Winter	Total
Start Date	5/13/2006	7/1/2006	9/1/2006	12/1/2006	1/16/2207	5/13/2006
End Date	6/30/2006	8/31/2006	10/31/2006	1/15/2006	2/25/2007	2/25/2007
Hours Covered	0630-2030	0630-2030	0700-1900	0830-1730	0830-1730	
Day Length (hr)	14	14	12	9	9	
AM work Shift	0630-1330	0630-1330	0700-1300	0830-1730	0830-1730	
PM work Shift	1331-2030	1331-2030	1301-1900			
Weekdays						
Number	34	43	42	33	28	180
Number Sampled	21	26	22	9	10	88
Number of Interviews	178	148	51	3	11	391
Weekend days (including Holidays)						
Number	15	19	19	17	13	83
Number Sampled	15	19	19	14	10	77
Number of Interviews	378	223	100	20	57	778
All days						
Number	49	62	61	50	41	263
Number Sampled	36	45	41	23	20	165
Number of Interviews	556	371	151	23	68	1169

Table 4. Estimated number of anglers per party and mean number of hours fished per party for Island Lake Reservoir (DOW # 69-037200) for the 2006-07 angling year by season.

Sampling Period Angling Type	N	Mean Number of Anglers per Party	SE	N	Mean Number of Hours Fished per Party	SE
Spring						
Boat	458	2.04	0.17	149	4.89	0.51
Bank	84	2.52	0.52	19	3.91	0.71
Dock	11	1.87	0.17	3	2.37	-
Total	553	2.06	0.71	171	4.74	1.13
Summer						
Boat	344	2.05	0.19	82	4.38	0.44
Bank	25	1.88	0.29	7	3.44	0.46
Dock	0	-	-	0	-	-
Total	369	2.04	0.30	89	4.26	0.28
Fall						
Boat	141	1.93	0.27	34	4.40	0.47
Bank	9	1.61	0.29	0	-	-
Dock	0	-	-	0	-	-
Total	150	1.91	0.16	34	4.40	-
Early Winter						
Ice House	14	1.96	0.14	4	4.35	-
Open Ice	9	1.68	0.25	3	2.00	-
Total	23	1.86	0.20	7	3.76	-
Later Winter						
Ice House	43	2.01	0.31	5	3.06	0.16
Open Ice	13	1.74	-	1	3.25	-
Vehicle	11	1.60	0.18	2	3.16	-
Total	67	1.71	0.17	8	3.15	-

Table 5. Estimated fishing pressure (angler hours) by angler type during open water periods for Island Lake Reservoir (DOW # 69-037200) from May 13, 2006 - October 31, 2006.

	Angler Type							
Season	Boat	SE	Shore	SE	Dock	SE	All	SE
Spring	26,134	2,523	6,604	1,063	2,468	622	35,206	3,294
Summer	20,608	1,673	2,390	539	363	116	23,361	1,876
Fall	6,912	1,046	635	197	23	23	7,570	1,086
Open Water	53,654	3,202	9,629	1,208	2,854	633	66,137	3,943

Table 6. Estimated fishing pressure (angler hours) by angler type during winter periods for Island Lake Reservoir (DOW # 69-037200) from December 1, 2006 - February 25, 2007.

	Angler Type							
Season	Fish House	SE	Open Ice	SE	Vehicle	SE	All	SE
Early Winter	638	259	231	156	0	0	869	281
Late Winter	12,020	10,113	1,393	1,031	17	17	13,430	11,139
Winter	12,658	10,117	1,624	1,043	17	17	14,299	11,143

Table 7. Estimated number of anglers targeting species on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

		BLC		SMB		NOP		MUE		YEP		WAE	
Sampling Period	N	#	%	#	%	#	%	#	%	#	%	#	%
Spring	556	1	0.2	17	3.1	6	1.1	13	2.3	2	0.4	436	78.4
Summer	371	1	0.3	11	3.0	5	1.3	35	9.4	0	0	269	72.5
Fall	151	8	5.3	3	2.0	3	2.0	21	13.9	0	0	100	66.2
Early Winter	23	5	21.7	0	0	0	0	0	0	0	0	12	52.2
Late Winter	68	9	13.2	0	0	3	4.4	0	0	0	0	26	38.2
Open Water	1078	10	0.9	31	2.9	14	1.3	69	6.4	2	0.2	805	74.7
Winter	91	14	15	0	0	3	3.3	0	0	0	0	38	41.8
Total	1169	24	2.1	31	2.7	17	1.5	69	5.9	2	0.2	843	72.1

Table 8. Estimated total catch, harvest, and release rates for all anglers and species targeted anglers for Island Lake Reservoir (DOW # 69-037200), 2006-2007 angling season.

		Overall						Targeted					
Species	Creel	Total Catch		Harvest		Release		Total Catch		Harvest		Release	
Sampling Period	Catch	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
Black Crappie													
Spring	9	0.003	-	0.001	0.001	0.002	-	0.000	0.000	0.000	0.000	0.000	0.000
Summer	21	0.015	0.009	0.007	0.004	0.009	0.007	0.114	-	0.114	-	0.000	-
Fall	23	0.037	0.023	0.033	0.011	0.004	0.008	0.409	0.260	0.388	0.259	0.021	0.014
Early Winter	13	0.139	0.050	0.121	0.045	0.018	0.006	0.430	-	0.373	-	0.058	-
Late Winter	8	0.004	0.005	0.004	0.005	0.000	0.000	0.147	0.135	0.147	0.135	0.000	0.000
Open Water	53	0.011	0.004	0.006	0.003	0.005	0.002	0.280	0.159	0.267	0.159	0.013	0.009
Winter	21	0.013	0.010	0.012	0.010	0.001	0.001	0.305	0.060	0.273	0.060	0.032	0.000
Total	74	0.011	0.003	0.007	0.002	0.004	0.002	0.286	0.118	0.269	0.118	0.018	0.007
Northern Pike													
Spring	175	0.056	0.018	0.005	0.003	0.050	0.016	0.381	0.096	0.063	0.000	0.318	0.096
Summer	65	0.038	0.011	0.003	0.002	0.035	0.010	0.532	0.253	0.000	0.000	0.532	0.253
Fall	39	0.070	0.031	0.012	0.014	0.058	0.022	1.101	-	0.000	-	1.101	-
Early Winter	2	0.031	-	0.000	-	0.031	-	-	-	-	-	-	-
Late Winter	10	0.020	0.030	0.006	0.010	0.014	0.020	0.444	-	0.444	-	0.000	-
Open Water	279	0.051	0.011	0.005	0.002	0.046	0.010	0.608	0.105	0.024	0.000	0.585	0.105
Winter	12	0.021	0.028	0.006	0.009	0.015	0.019	0.196	-	0.196	-	0.000	-
Total	291	0.046	0.011	0.005	0.002	0.040	0.010	0.567	0.095	0.041	0.000	0.526	0.095
Muskellunge													
Spring	4	0.001	0.001	0.000	0.000	0.001	0.001	0.010	0.015	0.000	0.000	0.010	0.015
Summer	13	0.006	0.002	0.000	0.001	0.006	0.002	0.038	0.040	0.000	0.000	0.038	0.040
Fall	1	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Early Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Late Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Open Water	18	0.003	0.001	0.000	0.000	0.003	0.001	0.018	0.016	0.000	0.000	0.018	0.016
Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	18	0.002	0.001	0.000	0.000	0.002	0.001	0.018	0.016	0.000	0.000	0.018	0.016

Table 8. Continued from previous page.

Species / Sampling Period	Reported Catch	Overall						Targeted					
		Total Catch		Harvest		Release		Total Catch		Harvest		Release	
		Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
Smallmouth Bass													
Spring	275	0.077	0.018	0.007	0.003	0.070	0.018	1.044	0.339	0.017	0.000	1.027	0.339
Summer	143	0.069	0.026	0.008	0.003	0.062	0.024	0.370	0.138	0.005	0.012	0.365	0.132
Fall	51	0.037	0.023	0.033	0.011	0.004	0.008	2.399	0.910	0.073	0.000	2.326	0.910
Early Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Late Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Open Water	469	0.072	0.014	0.007	0.002	0.065	0.014	0.891	0.193	0.018	0.005	0.873	0.192
Winter	0	-	-	-	-	-	-	-	-	-	-	-	-
Total	469	0.060	0.014	0.007	0.002	0.054	0.013	0.891	0.193	0.018	0.005	0.873	0.192
Yellow Perch													
Spring	91	0.033	0.010	0.007	0.002	0.026	0.010	0.148	-	0.148	-	0.000	-
Summer	73	0.041	0.015	0.011	0.003	0.030	0.013	-	-	-	-	-	-
Fall	34	0.047	0.025	0.006	0.008	0.041	0.015	-	-	-	-	-	-
Early Winter	9	0.076	0.036	0.006	0.015	0.069	0.031	-	-	-	-	-	-
Late Winter	21	0.034	0.035	0.009	0.011	0.025	0.027	-	-	-	-	-	-
Open Water	198	0.037	0.008	0.008	0.002	0.029	0.007	0.148	-	0.148	-	0.000	-
Winter	30	0.036	0.034	0.009	0.010	0.028	0.027	-	-	-	-	-	-
Total	228	0.037	0.009	0.008	0.002	0.029	0.008	0.148	-	0.148	-	0.000	-
Walleye													
Spring	1604	0.435	0.111	0.145	0.039	0.290	0.075	1.221	0.170	0.381	0.114	0.840	0.124
Summer	1076	0.561	0.095	0.233	0.044	0.328	0.056	1.542	0.392	0.684	0.194	0.859	0.250
Fall	439	0.546	0.257	0.189	0.162	0.358	-	1.219	0.485	0.431	0.161	0.788	0.462
Early Winter	12	0.096	0.075	0.086	0.067	0.010	0.010	0.282	0.037	0.259	0.037	0.023	0.001
Late Winter	16	0.038	0.032	0.020	0.017	0.058	0.058	0.499	0.079	0.340	0.061	0.160	0.053
Open Water	3119	0.492	0.076	0.181	0.032	0.311	0.046	1.339	0.202	0.506	0.093	0.833	0.158
Winter	28	0.042	0.033	0.024	0.019	0.018	0.014	0.406	0.048	0.305	0.038	0.101	0.030
Total	3147	0.412	0.081	0.153	0.033	0.259	0.050	1.185	0.169	0.473	0.078	0.713	0.132

Table 9. Estimated harvest and yield from Island Lake Reservoir (DOW # 69-037200) open water periods, 2006-07 angling season.

Season	Harvest			Yield		
Species	Total Number	SE	Number per Acre	Total Pounds	SE	Pounds per Acre
Spring						
Black Crappie	28	19	0.004	29	20	0.004
Smallmouth Bass	254	117	0.035	458	190	0.063
Northern Pike	188	81	0.026	595	300	0.081
Muskellunge	0	0	0.000	0	0	0.000
Yellow Perch	239	67	0.033	112	40	0.015
Walleye	5,119	800	0.698	3,820	1,195	0.521
Summer						
Black Crappie	152	62	0.021	181	35	0.025
Smallmouth Bass	181	66	0.025	317	121	0.043
Northern Pike	76	33	0.010	306	132	0.042
Muskellunge	10	10	0.001	-	-	-
Yellow Perch	249	74	0.034	154	29	0.021
Walleye	5,449	669	0.743	4,060	860	0.554
Fall						
Black Crappie	246	148	0.034	240	388	0.033
Smallmouth Bass	41	19	0.006	42	15	0.006
Northern Pike	89	102	0.012	346	397	0.047
Muskellunge	0	0	0.000	0	0	0.000
Yellow Perch	46	30	0.006	33	13	0.005
Walleye	1,429	722	0.195	1,076	331	0.147
Open Water						
Black Crappie	426	161	0.058	452	390	0.062
Smallmouth Bass	476	136	0.065	818	225	0.111
Northern Pike	354	135	0.048	1,248	516	0.170
Muskellunge	10	10	0.001	-	-	-
Yellow Perch	535	105	0.073	302	51	0.041
Walleye	11,997	1,268	1.636	8,956	1,508	1.221

Table 10. Estimated harvest and yield from Island Lake Reservoir (DOW # 69-037200) for winter periods, 2006-07 angling season.

Season	Harvest			Yield		
Species	Total Number	SE	Number per Acre	Total Pounds	SE	Pounds per Acre
Early Winter						
Black Crappie	105	20	0.014	79	-	0.011
Northern Pike	0	0	0.000	0	0	0.000
Yellow Perch	5	13	0.001	1	-	0.000
Walleye	75	32	0.010	62	42	0.008
Late Winter						
Black Crappie	59	41	0.008	42	31	0.006
Northern Pike	81	108	0.011	331	500	0.045
Yellow Perch	118	103	0.016	37	33	0.005
Walleye	267	33	0.036	227	66	0.031
Winter						
Black Crappie	164	46	0.022	119	31	0.016
Northern Pike	81	108	0.011	331	503	0.045
Yellow Perch	123	104	0.017	40	33	0.005
Walleye	342	46	0.047	291	79	0.040

Table 11. Average length and weight of harvested and released fish for Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

		Harvested				Released				
Sampling period		Length (in)		Weight (lb)			Length (in)		Weight (lb)	
Species	N	Mean	SE	Mean	SE	N	Mean	SE	Mean	SE
Open Water										
Black Crappie	38	11.6	0.2	1.07	0.08	15	9.3	0.6	0.63	0.12
Smallmouth Bass	36	13.7	0.3	1.69	0.13	433	13.1	0.2	1.65	0.05
Northern Pike	24	25.7	0.8	3.29	0.33	255	17.5	0.3	1.23	0.07
Muskellunge	1	33.5	-	9.77	-	17	36.5	1.5	14.44	2.05
Walleye	1192	13.1	0.05	0.72	0.01	1927	11.3	0.04	0.47	0.008
Yellow Perch	44	10.5	0.2	0.58	0.02	154	8.7	0.2	0.36	0.02
Winter										
Black Crappie	20	10.3	0.3	0.74	0.08	1	7.0	-	0.22	-
Smallmouth Bass	-	-	-	-	-	-	-	-	-	-
Northern Pike	3	26.1	3.25	3.50	1.22	9	16.9	0.6	0.87	0.10
Muskellunge	-	-	-	-	-	-	-	-	-	-
Walleye	22	13.7	0.3	0.82	0.06	6	9.9	0.7	0.31	0.07
Yellow Perch	8	8.5	0.6	0.31	0.06	22	7.0	0.2	0.17	0.01
Total										
Black Crappie	58	11.2	0.2	0.96	0.06	16	9.2	0.6	0.61	0.12
Smallmouth Bass	36	13.7	0.3	1.69	0.13	433	13.1	0.2	1.65	0.05
Northern Pike	27	25.7	0.8	3.32	0.31	264	17.4	0.3	1.22	0.07
Muskellunge	1	33.5	-	9.77	-	17	36.5	1.5	14.44	2.05
Walleye	1214	13.2	0.05	0.72	0.01	1933	11.3	0.04	0.47	0.008
Yellow Perch	52	10.2	0.2	0.54	0.03	176	8.5	0.1	0.33	0.02

Table 12. Length frequency distributions of black crappie (BLC), smallmouth bass (SMB), northern pike (NOP), yellow perch (YEP), and walleye (WAE) for total catch (T), fish harvested (H), and fish released (R) on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

	BLC			SMB			NOP			YEP			WAE		
Length (in)	T	H	R	T	H	R	T	H	R	T	H	R	T	H	R
<5.0				4		4				1		1			
5.0-5.9				2		2				3		3	3	1	2
6.0-6.9	3		3	8		8				27	2	25	21	2	19
7.0-7.9	3	1	2	17		17				38	2	36	13		13
8.0-8.9	3	1	2	18		18	1		1	45	6	39	82	4	78
9.0-9.9	10	7	3	23		23	1		1	17	8	9	177	7	170
10.0-10.9	20	19	1	32	3	29	16		16	55	14	41	305	35	270
11.0-11.9	11	10	1	31	2	29	5		5	12	7	5	932	160	772
12.0-12.9	18	15	3	45	5	40	25		25	26	12	14	626	297	329
13.0-13.9	1	1		84	8	76	20		20	4	1	3	492	297	195
14.0-14.9	4	3	1	61	8	53	21		21				286	229	57
15.0-15.9				36	4	32	36		36				104	103	1
16.0-16.9				21	3	18	15		15				48	47	1
17.0-17.9	1	1		72	2	70	13	2	11				35	19	16
18.0-18.9				12	1	11	11		11				10	8	2
19.0-19.9				2		2	7		7				3	1	2
20.0-20.9							36	1	35				3	3	
21.0-21.9				1		1	9		9				1		1
22.0-22.9							7	1	6				1		1
23.0-23.9							6	5	1						
24.0-24.9							15	2	13				1		1
25.0-25.9							9	3	6						
26.0-26.9							10	3	7				2		2
27.0-27.9							2	2							
28.0-28.9							13	3	10				2	1	1
29.9-29.9							2	1	1						
30.0-30.9							6	1	5						
31.0-31.9							4	2	2						
32.0-32.9															
33.0-33.9															
34.0-34.9															
35.0-35.9															
36.0-36.1							1	1							
Sample Size	74	58	16	469	36	433	291	27	264	228	52	176	3147	1214	1933

Muskellunge Lengths (in): 25, 30, 31, 33.5, 6 fish at 34, 36, 37, 38, 40, 41, 42, 46.5, 49.5

Table 13. Statistics on residence, gender, age, and angler type from interviews conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Demographic Description Categories	N	%
Residence		
Total Responses	2421	
Local (Island Lake Zip Code)	154	6.4
Duluth Metropolitan	1854	76.6
Cloquet/Esko, MN	73	3.0
Superior, WI	19	0.8
State of Minnesota	2293	94.7
Out of State	128	5.3
States: CA, CO, FL, IA, IL, IN, MD, MI, MO, MT, NE, OH, OK, SD, WI		
Gender		
Total Responses	2444	
Male	2039	83.4
Female	405	16.6
Age		
Total Responses	2412	
0-15	224	9.3
16-24	206	8.5
25-34	474	19.7
35-44	556	23.0
45-54	613	25.4
55-64	248	10.3
65+	91	3.8
Open Water Angler Type		
Total Responses	2237	
Boat	1977	88.4
Shore	240	10.7
Dock	20	0.9
Winter Angler Type		
Total Responses	215	
Fish House	151	70.2
Open Ice	42	19.6
Other	22	10.2

Table 14. Statistics on access used, boat motor, fishing methods, and bait used from interviews conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Demographic Description	Open Water		Winter	
Choices	N	%	N	%
Access Used				
Dam Road Public Access	114	10.6	0	0.0
West Bay Public Access	268	24.9	1	1.1
Hideaway Public Access	119	11.0	5	5.5
Resort	44	4.1	4	4.4
Private Residence	378	35.1	72	79.1
Public Road Right-of-Way	90	8.3	7	7.7
Other / Undefined	65	6.0	2	2.2
Outboard Size				
None	10	1.0	-	-
Inboard	22	2.3	-	-
<10	54	5.7	-	-
10 - 25	159	16.8	-	-
25.1 - 50	295	31.1	-	-
50.1 - 100	215	22.7	-	-
>100	193	20.4	-	-
Trolling Motor Used				
No	191	20.1	-	-
Yes	757	79.9	-	-
Fishing Method				
Casting	79	7.3	-	-
Drifting	84	7.8	-	-
Fly	5	0.5	-	-
Still	613	56.9	85	93.4
Trolling	238	22.1	-	-
Mixed	39	3.6	1	0.1
Tip-Up	-	-	5	0.5
Undefined	20	1.8	-	-
Bait Used				
Leeches	84	7.8	-	-
Minnows	436	40.5	72	79.1
Worms	87	8.1	-	-
Artificial	147	13.6	-	-
Mixed	317	29.4	15	16.5
Undefined	7	0.6	4	4.4

Total Fishing Parties Summer = 1,078 Winter = 91
Total Boats = 948

Figures

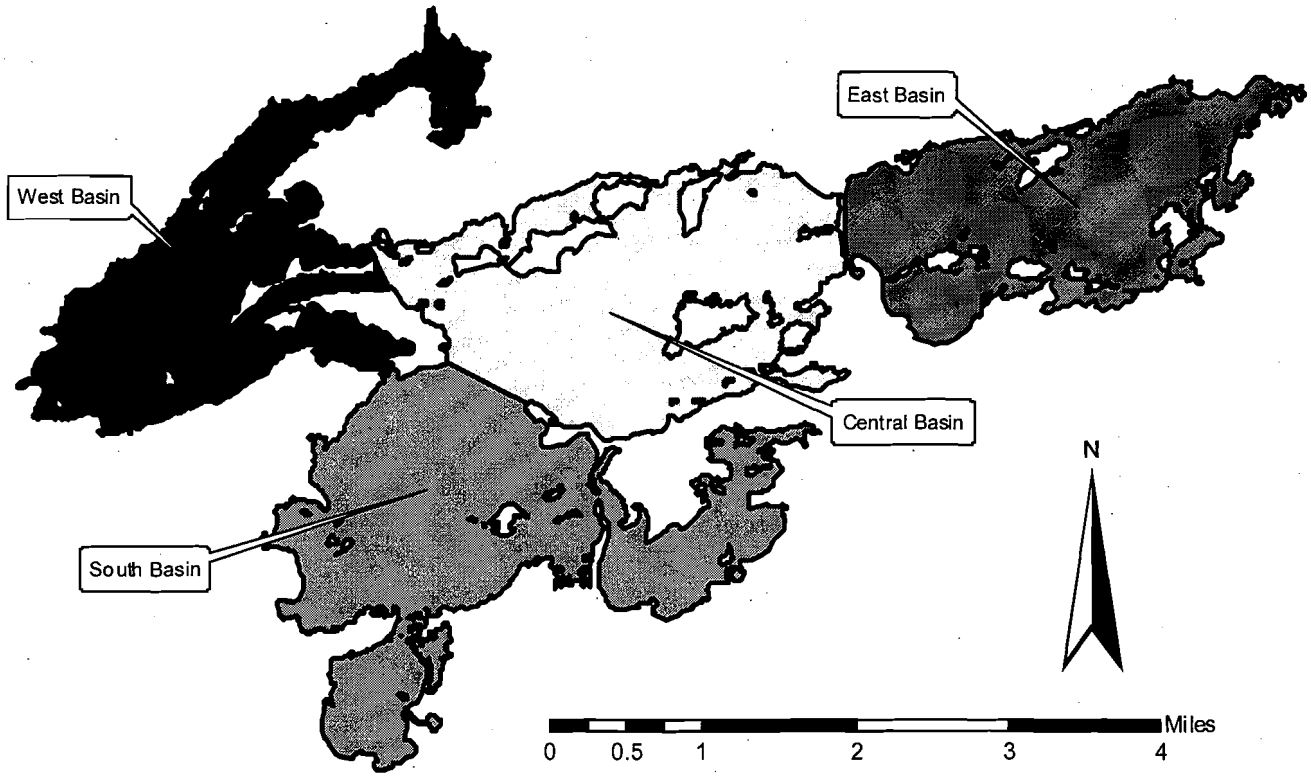

Figure 1. Island Lake Reservior (DOW # 69-037200) basin delineations for a creel conducted during the 2006-07 angling season.

Thursday	
	25
Shift	PM
Direction	CW
Basin 1:	West
Count 1:	1340
Basin 2:	South
Count 2:	1815

Figure 2. Example of a scheduled work day for the creel study on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

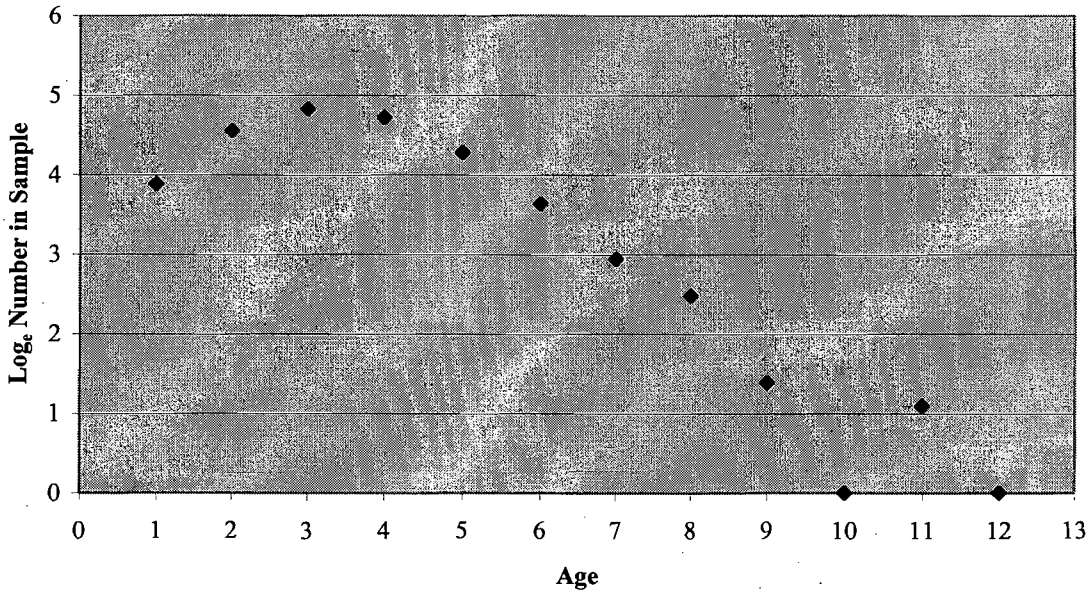

Figure 3. Walleye catch curve derived from combining 1998, 2003, and 2006 Minnesota Department of Natural Resources survey data for Island Lake Reservoir, (DOW # 69-037200).

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Appendices

Appendix 1. Open water activity report form for the creel conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Minnesota Department of Natural Resources
Section of Fisheries

Creel Survey Activity Report

Lake/DOW	Date			Day Type	Clerk	Basin	Water Temp	Wind Code	Wind Direct	Weather	Secchi Depth
	Month	Day	Year								
Island (69-372)											

Open Water Count 1	*Time (Military):*	
Count Type	**Tally**	**Total**
Fishing Boat		
Bank Angler		
Dock Angler		
Runabouts		
Sailboats		
Pontoon Boats		
Non-motorized		
Jet Skis		

Comments: _____

Lake/DOW	Date			Day Type	Clerk	Basin	Water Temp	Wind Code	Wind Direct	Weather	Secchi Depth
	Month	Day	Year								
Fish Lake (69-0491)											

Open Water Count 2	*Time (Military):*	
Count Type	**Tally**	**Total**
Fishing Boat		
Bank Angler		
Dock Angler		
Runabouts		
Sailboats		
Pontoon Boats		
Non-motorized		
Jet Skis		

Comments: _____

Dictionary for Activity Report

Day Type	Code	Basin	Code	Wind	Code	Wind Dir.	Code	Weather	Code
Weekdays	1	Central	C	Calm	C	North	N	Clear	C
Weekends-Holidays	2	East	E	Light	L	South	S	Overcast	O
		South	S	Moderate	M	East	E	Rain	R
		West	W	Strong	S	West	W	Snow	S
						N-East	NE	Partly Cloudy	P
						N-West	NW	Fog	F
						S-East	SE	Thunderstorm	T
						S-West	SW		

Appendix 2. Open water interview form for a creel conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Minnesota Department of Natural Resources
Section of Fisheries

Creel Survey Interview Report

Lake/DOW	Date			Day Type	Clerk	Basin	Interview Number	Start Time (Military)	End Time (Military)	Total Time Fishing (Hours, Tenths)	No. in Party
	Month	Day	Year								
Island/(69-372)											

Access Type	Species Sought	Complete/Incomplete	Number Lines	Angler Type	Method Fishing	Lure Type	Boat Description	Motor Size	Motor Type	Trolling Motor	Electronics	Gender, Age & ZIP Codes			Refused Interview
	1												G	A	Zip Code	
	2											1				
												2				
												3				
												4				
												5				

M = Kept and Measured by Creel Clerk N = Kept and NOT Measured by Creel Clerk R = released by angler

	Species	MNR	Number	Length (units, tenths)	Weight (units, tenths)	Tag Number	Comments
1				.	.		
2				.	.		
3				.	.		
4				.	.		
5				.	.		
6				.	.		
7				.	.		
8				.	.		
9				.	.		
10				.	.		
11				.	.		
12				.	.		
13				.	.		
14				.	.		
15				.	.		
16				.	.		
17				.	.		
18				.	.		
19				.	.		
20				.	.		

Comments: _____

Appendix 3. Winter activity report form for the creel conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Minnesota Department of Natural Resources
Section of Fisheries

Creel Survey Activity Report

Lake/DOW	Date			Day Type	Clerk	Basin	Wind Code	Wind Direct	Weather	Ice Cond.	Slush Y/N	Seechi
	Month	Day	Year									
Island (69-372)												

Ice Count 1		*Time (Military):*
Count Type	**Tally**	**Total**
Permanent Ice House		
Portable Ice House		
Open-ice angler		
Other: Specify		

Comments: _____

Lake/DOW	Date			Day Type	Clerk	Basin	Wind Code	Wind Direct	Weather	Ice Cond.	Slush Y/N	Seechi
	Month	Day	Year									
Fish Lake (69-0491)												

Ice Count 2		*Time (Military):*
Count Type	**Tally**	**Total**
Permanent Ice House		
Portable Ice House		
Open-ice angler		
Other: Specify		

Comments: _____

Dictionary for Activity Report

Day Type	Code
Weekdays	1
Weekends-Holidays	2

Ice Condition	Code
Thin (0-4")	T
ATV Safe (5-8")	A
Small Car (9-12")	C
Thick (>12")	G

Basin	Code
Central	C
East	E
South	S
West	W

Wind	Code
Calm	C
Light	L
Moderate	M
Strong	S

Wind Dir.
North
South
East
West
N-East
N-West
S-East
S-West

Weather	Code
Clear	C
Overcast	O
Rain	R
Snow	S
Partly Cloudy	P
Fog	F
Thunderstorm	T

Appendix 4. Open water interview form for a creel conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Minnesota Department of Natural Resources
Section of Fisheries

Creel Survey Interview Report

Lake/DOW	Date			Day Type	Clerk	Basin	Interview Number	Start Time (Military)	End Time (Military)	Total Time Fishing (Hours, Tenths)	No. in Party
	Month	Day	Year								
Island/(69-372)											

Access Type	Species Sought	Complete/Incomplete	Number Lines	Angler Type V PO PE	Method Fishing	Lure Type	Electronics	Gender, Age & ZIP Codes:	G	A	Zip Code	Retised Interview	Waypoint Number	Nearest Angler	Group/Individual
	1							1							
	2							2							
								3							
								4							
								5							

Distance Code	
1	0-50ft
2	50-100ft
3	100-300ft
4	300+ft

	Species	MNR	Number	Length (units, tenths)	Weight (units, tenths)	Tag Number	Comments
1				.	.		
2				.	.		
3				.	.		
4				.	.		
5				.	.		
6				.	.		
7				.	.		
8				.	.		
9				.	.		
10				.	.		
11				.	.		
12				.	.		
13				.	.		
14				.	.		
15				.	.		
16				.	.		
17				.	.		
18				.	.		
19				.	.		
20				.	.		

Comments:

M = Kept and Measured by Creel Clerk N = Kept and Not Measured by Creel Clerk R = released by angler

Appendix 5. Code sheet for a creel conducted on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Dictionary for Interview Report

Day Type	Code
Weekdays	1
Weekends-Holidays	2

Angler Type	Code
Boat	B
Bank	K
Dock	D
Fish House	F
Open Ice	O
Spear Fishing	S

Boat Description	Code
Canoe/Kayak /Rowboat	C
Fishing	F
House boat/ Cruiser	H
Pontoon	
Camper	K
Launch	L
Runabout	R
Sailboat	S

Access Type	Code
Resort or Private Recreation Area	R
Private Residence	P
Public Road Right-of-Way	W
Dead-End Road	D
Trail	T
Fly-In	F
Public Access	01 = Dam Road
	02 = Abbott Rd
	03 = Hideaway
Other	O

Method Fishing	Code
Cast	C
Drift	D
Fly	F
Mixed	M
Still	S
Troll	T
Tipup	P

Species Sought	Code
Black Bullhead	BLB
Black Crappie	BLC
Brown Bullhead	BRB
Largemouth Bass	LMB
Muskellunge	MUE
Northern Pike	NOP
Pumpkinseed	PMK
Rock Bass	RKB
Smallmouth Bass	SMB
Walleye	WAE
Yellow Perch	YEP
Panfish	PAN
Suckers	OTS
No Particular Species	NPS

Lure Type	Code
Artificial	A
Leach	L
Minnow	M
Prepared (Stink)	P
Worm	W
Mixed	X

Age	Code
0-15	1
16-24	2
25-34	3
35-44	4
45-54	5
55-64	6
Over 64	7

Gender	Code
Male	M
Female	F

Motor Type	Code
Outboard	O
I/O	B
Inboard	I
Electric	E
No Motor	N

Electronics	Code
GPS	G
Loran	L
Locator	F
Camera	C

Appendix 6. Postcard questionnaire given to interviewed anglers in conjunction with a creel on Island Lake Reservoir (DOW # 69-037200), 2006-07 angling season.

Island Lake Completed Trip Questionnaire

Date:_____ Interview #_____

Please answer the following questions. Your answers should apply to your party (the people in your boat or with you on shore), and only to the time your party spent fishing on this lake today. Thank you for your cooperation!

How many anglers in your party? _____
How many hours did your party fish? _____

Please provide as much of the following information as possible:

Species	Number Kept	Number Released	Ave. Size Fish Kept	Ave. Size Fish Released
Walleye (no tag)				
Walleye (tagged)				
Other				
Other				

If you kept any tagged walleye, please record the tag numbers from those fish here:

_____

If you'd like information on the tagged walleye, write your return address below:_____

_____

_____

Minnesota
F-29-R(P)-27
Area 213
Study 4
Job 802
3/27/2008

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
SECTION OF FISHERIES

Completion Report

Estimating Creel Statistics and Walleye Exploitation on Island Lake Reservoir (DOW # 69-037200), Minnesota using a Stratified Random, Roving Creel Survey and Walleye Tagging

By

Nick Frohnauer

Prepared by: Nick Frohnauer

Approved by: _____ 3/27/08
Area Supervisor Date

Approved by: _____ 4/2 9/08
Regional Supervisor Date

Funded Under Federal Aid by the Sport Fish Restoration Act, F-29-R(P)-27
in cooperation with Fond du Lac Reservation and 1854 Treaty Authority